

amended. Applicants believe that claims 1-15 are now in condition for allowance. The Examiner's objections and rejections are respectfully traversed below.

Objection to the Drawings

In the Office Action, the Examiner objected to the drawings for not showing every feature of the invention specified in the claims. The Examiner identified the medium passage, the hydrogen passage(s), the heat medium and the main passage as features that must be shown or cancelled from the claim(s).

Applicants respectfully submit that each of the above-named features identified by the Examiner is present in the drawings as demonstrated below:

The medium passage

The substantially U-shaped heat medium passage is formed from ducts 7a, 7b, and 8 and is illustrated in Figures 1 to 6. *See* specification page 14, lines 16-18.

The hydrogen passage

The hydrogen passage is identified with the numeral 13 and is illustrated in Figures 1(a), 7(a), and 7(b). *See* specification page 8, lines 22-30.

The heat medium

The header 6 (shown in Figures 3 and 4) supplies the heat medium 11, as illustrated in Figure 1(b). *See* specification page 6, lines 11-14. Additionally, the heat medium flows from the upstream chamber 6a to the downstream chamber 6b through the upstream ducts 7a, the connecting ducts 8, and the downstream ducts 7b, as illustrated in Figures 3 and 4. *See* specification page 7, lines 18-21.

The main passage

The main passage 11 is illustrated in Figure 1(b). *See* specification page 8, lines 11-14.

For the foregoing reasons, Applicants respectfully request that the Examiner withdraw the objection to the drawings.

Rejection Under 35 U.S.C. §112

In the Office Action, the Examiner rejected claims 1-15 under 35 U.S.C. §112, second paragraph, as being indefinite for failing to particularly point out and distinctly claim the subject matter which applicant regards as the invention. Applicants have amended claims 1 and 10 to correct for these informalities. Accordingly, withdrawal of the Examiner's rejection is respectfully requested.

Rejection Under 35 U.S.C. §102(b) – Rockenfeller et al.

In the Office Action, the Examiner rejected claims 1-2, 4 and 8-9 under 35 U.S.C. § 102(b) as being anticipated by U.S. Patent No. 5,165,247 (Rockenfeller et al.). However, the Examiner has not identified where each limitation of the rejected claims is allegedly found in Rockenfeller et al..

The present invention is drawn to a reservoir for storing hydrogen comprising a housing, a molded body accommodated in the housing wherein the molded body is formed by compressing a hydrogen storage material powder, a heat medium passage and a hydrogen passage. *See* claim 1. The advantage of compressing the hydrogen storage material into a molded body is an increase in heat conductivity. This is illustrated in Figure 5 and explained in the specification at page 11, lines 26-34 (emphasis added):

Fig. 5 is a graph representing the heat conductivity of an HM molded body and the copper rate of the same. Sample A is HM powder as a reference example. Sample B is an HM molded body that contains zero weight percent of copper. Sample C is an HM molded body that contains thirty weight percent of copper. Sample D is an HM molded body that contains fifty weight percent of copper. As shown in Fig. 5, even Sample B has an increased heat conductivity, as compared to Sample A, which is HM powder.

In contrast, Rockenfeller et al. is directed to an apparatus for being permanently or selectively installed with a refrigeration or chemical system whereby a gas may be evacuated from the system and adsorbed on a solid adsorbent material, and later desorbed and returned to the system. Col. 1, lines 25-30. The physical structure of the "solid adsorbent material" is not one of a molded body, as a barrier is necessary to retain the solid adsorbent particles in place:

method *structure*

Extending around the exterior of the solid adsorbent is a barrier 16 for retaining the solid adsorbent particles or mass in place around the pipes and in contact with the heat exchange plates or surfaces.

Col. 2, lines 60-63. Thus, Rockenfeller et al. fails to disclose a molded body formed by compressing a hydrogen storage material powder.

As claims 1-2, 4 and 8-9 all recite this molded body limitation, Rockenfeller et al. cannot anticipate these claims. Accordingly, withdrawal of the Examiner's rejection is respectfully requested.

Rejection Under 35 U.S.C. §102(b) – Asami et al.

In the Office Action, the Examiner rejected claims 1-4, 6-7 and 9 under 35 U.S.C. § 102(b) as being anticipated by U.S. Patent No. 4,393,924 (Asami et al.). However, the Examiner has not identified where each limitation of the rejected claims is allegedly found in Asami et al..

The present invention is drawn to a reservoir for storing hydrogen comprising a housing, a molded body accommodated in the housing wherein the molded body is formed by compressing a hydrogen storage material powder, a heat medium passage and a hydrogen passage. *See* claim 1. As described above, the advantage of compressing the hydrogen storage material into a molded body is an increase in heat conductivity. This is illustrated in Figure 5 and explained in the specification at page 11, lines 26-34.

In contrast, Asami et al. is directed to a heat exchange apparatus for use with hydrogen storing material, which is characterized in that a regenerator chamber packed with a heat storing material is disposed in between a high temperature fluid pathway and a low temperature pathway of the heat exchanger. Col. 2, lines 9-14. The physical structure of the hydrogen storing material is not one of a molded body formed by compressing a hydrogen storage material powder:

The hydrogen storing material which is packed in regenerator chamber 4 is a material prepared by pulverizing an intermetallic compound such as iron-titanium into fine powder, mixing the fine powder with an alumina gel, a silica gel or other stable inorganic or organic carrier, and solidifying the mixture by baking it in an atmosphere suitable to it such as under vacuum or in an inert gas atmosphere or by forming with use of an appropriate binder.

Col. 4, lines 54-62. Thus, Asami et al. fails to disclose a molded body formed by compressing a hydrogen storage material powder.

As claims 1-4, 6-7 and 9 all recite this molded body limitation, Asami et al. cannot anticipate these claims. Accordingly, withdrawal of the Examiner's rejection is respectfully requested.

Rejection Under 35 U.S.C. §103(a) – Rockenfeller et al. and Asami et al.

In the Office Action, the Examiner rejected claim 5 under 35 U.S.C. §103(a) as being unpatentable over U.S. Patent No. 5,165,247 (Rockenfeller et al.) and U.S. Patent No. 4,393,924 (Asami et al.). According to the Examiner, Rockenfeller et al. and Asami et al. disclose all the claimed features of the invention, with the exception of copper as the highly heat conductive material.

However, as demonstrated above, Rockenfeller et al. and Asami et al. do not disclose all the claimed features of the invention. The present invention is drawn to a reservoir for storing hydrogen comprising a housing, a molded body accommodated in the housing wherein the molded body is formed by compressing a hydrogen storage material powder, a heat medium passage, a heat medium and a hydrogen passage. *See* claim 5. Rockenfeller et al. discloses solid adsorbent particles which are retained in place by a barrier. Col. 2, lines 60-63. Asami et al. discloses baked particles or particles held together by a binder. Col. 4, lines 54-62. Neither Rockenfeller et al. nor Asami et al. discloses a molded body formed by compressing a hydrogen storage material powder. Accordingly, withdrawal of the Examiner's rejection is respectfully requested.

Rejection Under 35 U.S.C. §103(a) – Rockenfeller et al. in view of Nikai, Januschkowetz or Yanagi et al.

In the Office Action, the Examiner rejected claims 3, 6-7 and 10-12 under 35 U.S.C. 103 as being unpatentable over U.S. Patent No. 5,165,247 (Rockenfeller et al.) in view of JP 3-31663 (Nikai), U.S. Patent No. 4,581,049 (Januschkowetz) or JP 3-244974 (Yanagi et al.). According to the Examiner, Rockenfeller et al. discloses all the claimed features of the invention with the exception of the claimed shapes – a flat duct, a molded body with a plate-like shape, a flat heat medium passage and a flat hydrogen passage.

However, as demonstrated above, Rockenfeller et al. does not disclose all the claimed features of the invention. The present invention is drawn to a reservoir for storing hydrogen comprising a housing, a molded body accommodated in the housing wherein the molded body is formed by compressing a hydrogen storage material powder, a heat medium passage and a hydrogen passage (claims 3 and 6-7). Additionally, the present invention is drawn to a reservoir for storing hydrogen comprising a housing, a plurality of storage units stacked in the interior of the housing, wherein each storage unit includes a pair of plate-like molded bodies formed by compressing a hydrogen storage material powder, a heat exchanger and a plurality of flat hydrogen passages (claims 10-12). Rockenfeller et al. discloses solid adsorbent particles which are retained in place by a barrier. Col. 2, lines 60-63. Rockenfeller et al. does not disclose a molded body formed by compressing a hydrogen storage material powder.

Neither Nikai, Januschkowetz or Yanagi et al. make up for the deficiencies of Rockenfeller. Nikai is drawn to an adsorption type freezer. *See Abstract.* Januschkowetz is drawn to a solid absorber apparatus for a cyclic absorption process. *See Col. 4, lines 36-37.* Yanagi et al. is drawn to an adsorption type freezing device. *See Abstract.* Nikai, Januschkowetz or Yanagi et al. were cited by the Examiner as showing flow passages being flat for the purpose of obtaining a compact heat exchanger. None of these references teaches a molded body formed by compressing a hydrogen storage material powder. Thus, their combination with Rockenfeller et al. would not render obvious claims 3, 6-7 and 10-12.

Accordingly, withdrawal of the Examiner's rejection is respectfully requested.

Rejection Under 35 U.S.C. §103(a) – Rockenfeller et al. in view of Nikai, Januschkowetz or Yanagi et al. and further in view of Onishi et al.

In the Office Action, the Examiner rejected claim 13 under 35 U.S.C. 103 as being unpatentable over U.S. Patent No. 5,165,247 (Rockenfeller et al.) in view of JP 3-31663 (Nikai),

U.S. Patent No. 4,581,049 (Januschkowetz) or JP 3-244974 (Yanagi et al.) in view of JP 62-288495 (Onishi et al.). According to the Examiner, Rockenfeller et al. in view of Nikai, Januschkowetz or Yanagi et al. discloses all the claimed features of the invention with the exception of the body including a chamfer.

However, as demonstrated above, Rockenfeller et al., as modified, does not disclose all the claimed features of the invention. The present invention is drawn to a reservoir for storing hydrogen comprising a housing, a plurality of storage units stacked in the interior of the housing, wherein each storage unit includes a pair of plate-like molded bodies formed by compressing a hydrogen storage material powder, a heat exchanger and a plurality of flat hydrogen passages. *See* claim 10. Rockenfeller et al., as modified, does not disclose a molded body formed by compressing a hydrogen storage material powder.

Onishi et al. does not make up for the deficiencies of Rockenfeller et al., as modified. Onishi et al. is drawn to a heat exchanger. *See* Abstract. The Examiner cited Onishi et al. for disclosing bodies including a chamfer for the purpose of having an efficient packing of the bodies within a housing which increases the filling rate of hydrogen. Onishi et al. does not teach a molded body formed by compressing a hydrogen storage material powder. Thus, its combination with Rockenfeller et al., as modified, would not render obvious claim 13.

Accordingly, withdrawal of the Examiner's rejection is respectfully requested.

Rejection Under 35 U.S.C. §103(a) – Rockenfeller et al. in view of Nikai, Januschkowetz or Yanagi et al. and further in view of Davis

In the Office Action, the Examiner rejected claim 14 under 35 U.S.C. 103 as being unpatentable over U.S. Patent No. 5,165,247 (Rockenfeller et al.) in view of JP 3-31663 (Nikai), U.S. Patent No. 4,581,049 (Januschkowetz) or JP 3-244974 (Yanagi et al.) in view of U.S. Patent

No. 6,237,680 B1 (Davis). According to the Examiner, Rockenfeller et al. in view of Nikai, Januschkowetz or Yanagi et al. discloses all the claimed features of the invention with the exception of a connecting section between upstream and downstream sections.

However, as demonstrated above, Rockenfeller et al., as modified, does not disclose all the claimed features of the invention. The present invention is drawn to a reservoir for storing hydrogen comprising a housing, a plurality of storage units stacked in the interior of the housing, wherein each storage unit includes a pair of plate-like molded bodies formed by compressing a hydrogen storage material powder, a heat exchanger and a plurality of flat hydrogen passages. *See* claim 10. Rockenfeller et al., as modified, does not disclose a molded body formed by compressing a hydrogen storage material powder.

Davis does not make up for the deficiencies of Rockenfeller et al., as modified. Davis is drawn to a radiator which utilizes laminar flow to more efficiently cool a liquid coursing through the radiator. Col. 1, lines 6-8. The Examiner cited Davis for disclosing that it is known to have a connecting section between upstream and downstream sections for the purpose of increasing the fluid flow length which increases the time the fluid exchanges heat which increases the overall heat exchange efficiency. Davis does not teach a molded body formed by compressing a hydrogen storage material powder. Thus, its combination with Rockenfeller et al., as modified, would not render obvious claim 14.

Accordingly, withdrawal of the Examiner's rejection is respectfully requested.

Rejection Under 35 U.S.C. §103(a) – Rockenfeller et al. in view of Nikai, Januschkowetz or Yanagi et al. and further in view of Davis, and still further in view of Farfaletti-Casali et al.

In the Office Action, the Examiner rejected claim 15 under 35 U.S.C. 103 as being unpatentable over U.S. Patent No. 5,165,247 (Rockenfeller et al.) in view of JP 3-31663 (Nikai),

U.S. Patent No. 4,581,049 (Januschkowetz) or JP 3-244974 (Yanagi et al.) in view of U.S. Patent No. 6,237,680 B1 (Davis) and still further in view of U.S. Patent No. 4,362,207 (Farfaletti-Casali et al.). According to the Examiner, Rockenfeller et al., as modified discloses all the claimed features of the invention with the exception of the header including both upstream and downstream sections.

However, as demonstrated above, Rockenfeller et al., as modified, does not disclose all the claimed features of the invention. The present invention is drawn to a reservoir for storing hydrogen comprising a housing, a plurality of storage units stacked in the interior of the housing, wherein each storage unit includes a pair of plate-like molded bodies formed by compressing a hydrogen storage material powder, a heat exchanger and a plurality of flat hydrogen passages. *See claim 10.* Rockenfeller et al., as modified, does not disclose a molded body formed by compressing a hydrogen storage material powder.

Farfaletti-Casali et al. does not make up for the deficiencies of Rockenfeller et al., as modified. Farfaletti-Casali et al. is drawn to an integrated system adapted to use and exploit substances in solid and paste form which are capable of exo-endothermic thermochemical reactions as a means for term storage of thermal energy. Col. 1, lines 6-11. The Examiner cited Farfaletti-Casali et al. for disclosing that it is known to have a header including upstream and downstream sections for the purpose of reducing the number of parts and reducing overall size, weight and cost. Farfaletti-Casali et al. does not teach a molded body formed by compressing a hydrogen storage material powder. Thus, its combination with Rockenfeller et al., as modified, would not render obvious claim 15.

Accordingly, withdrawal of the Examiner's rejection is respectfully requested.

CONCLUSION

For all the reasons advanced above, Applicants respectfully submit that the application is in condition for allowance and that action is earnestly solicited.

The Commissioner is hereby authorized to charge any additional fees which may be required for this amendment, or credit any overpayment to Deposit Account No. 13-4500, Order No. 5000-4853.

In the event that an extension of time is required, or may be required in addition to that requested in a petition for an extension of time, the Commissioner is requested to grant a petition for that extension of time which is required to make this response timely and is hereby authorized to charge any fee for such an extension of time or credit any overpayment for an extension of time to Deposit Account No. 13-4500, Order No. 5000-4853.

Respectfully submitted,
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Dated: September 5, 2002

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Amendments Showing Insertions and Deletions**IN THE SPECIFICATION**

Please amend the first paragraph on page 1 of the specification as follows:

The present invention relates to reservoirs with hydrogen storage [hydrogenstorage] material for selectively storing and discharging hydrogen.

Please amend the second paragraph on page 1 of the specification as follows:

Like solar energy, hydrogen energy is now widely known as clean energy. However, to actually produce energy with hydrogen, easy storage and transportation of the substance is indispensable. Hydrogen storage [Hydrogenstorage] material (hereinafter referred to as "HM"), which is, for example, an alloy, is considered as a solution to this problem. HM absorbs hydrogen to become a hydride at a certain pressure and at a certain temperature and releases hydrogen at a different pressure and at a different temperature. HM is used as a hydrogen supply in hydrogen engines and fuel cells, which are now under development. Likewise, heat pumps that use HM are now being developed. More specifically, the heat pumps use exothermic reaction and endothermic reaction caused by HM. The exothermic reaction takes place when HM absorbs hydrogen, and the endothermic reaction takes place when HM releases hydrogen.

Please amend the paragraph bridging pages 1 and 2 of the specification as follows:

It is thus preferred that a reservoir with hydrogen storage [hydrogenstorage] material (hereinafter referred to as "HM reservoir") includes a heat exchanger. The heat exchanger allows HM to operate smoothly. Japanese Unexamined Patent Publication No. 6-193996 describes an HM reservoir shown in Fig. 8. The HM reservoir includes an outer housing 50 and an inner housing 51. The inner housing 51 accommodates a heat

exchanger 54. The heat exchanger 54 includes a heat pipe 52 and a plurality of fins 53, which are aligned along the heat pipe 52. Each space between adjacent fins 53 is filled with HM powder (not shown). Hydrogen gas is supplied to the interior of the inner housing 51 through a hydrogen pipe 55. The gas is discharged to the exterior of the inner housing 51 through the hydrogen pipe 55.

Please amend the third full paragraph on page 3 of the specification as follows:

Accordingly, it is an objective of the present invention to provide a reservoir with hydrogen storage [hydrogenstorage] material that has a simple structure and enables the hydrogen storage [hydrogenstorage] material to smoothly absorb hydrogen and smoothly release the same.

Please amend the paragraph bridging pages 3 and 4 of the specification as follows:

To achieve the foregoing and other objectives and in accordance with the purpose of the present invention, the invention provides a reservoir for storing hydrogen that includes a housing and a molded body accommodated in the housing. The molded body is formed by compressing a hydrogen storage [hydrogenstorage] material powder. The molded body causes exothermic reaction when absorbing [the] hydrogen and causes endothermic reaction when releasing [the] hydrogen. The molded body has a first side and a second side opposite to the first side. The reservoir also includes a heat medium passage formed in the interior of the housing to face the first side of the molded body. Heat is transmitted from the molded body to a heat medium in the heat medium passage when the molded body absorbs [the] hydrogen, and heat is transmitted from the heat medium in the heat medium passage to the molded body when the molded body releases [the] hydrogen. The reservoir further includes a hydrogen passage formed in the interior

of the housing to face the second side of the molded body.

IN THE CLAIMS

Please amend claim 1 as follows:

1. (Once Amended) A reservoir for storing hydrogen, comprising:

a housing;

a molded body accommodated in the housing, wherein the molded body is formed by compressing a hydrogen storage [hydrogenstorage] material powder, the molded body causes exothermic reaction when absorbing [the] hydrogen and causes endothermic reaction when releasing [the] hydrogen, and the molded body has a first side and a second side opposite to the first side;

a heat medium passage formed in the interior of the housing to face the first side of the molded body, wherein heat is transmitted from the molded body to a heat medium in the heat medium passage when the molded body absorbs [the] hydrogen, and heat is transmitted from the heat medium in the heat medium passage to the molded body when the molded body releases [the] hydrogen; and

a hydrogen passage formed in the interior of the housing to face the second side of the molded body.

Please amend claim 10 as follows:

10. (Once Amended) A reservoir for storing hydrogen, comprising:

a housing;

a plurality of storage units stacked in the interior of the housing, wherein each storage unit includes:

a pair of plate-like molded bodies formed by compressing a hydrogen storage [hydrogenstorage] material powder, wherein each molded body causes exothermic reaction when absorbing [the] hydrogen and causes endothermic reaction when releasing [the] hydrogen, the molded body includes a first flat side and a second flat side opposite to the first side, and the molded bodies are located with respect to each other such that the first sides face each other; and

a heat exchanger located between the molded bodies, wherein the heat exchanger includes a flat duct in which a heat medium flows, the duct contacts the first side of each molded body, heat is transmitted from the molded bodies to the heat medium in the duct when the molded bodies absorb [the] hydrogen, and heat is transmitted from the heat medium in the duct to the molded bodies when the molded bodies release [the] hydrogen; and

a plurality of flat hydrogen passages formed in the interior of the housing to face the second sides of the molded bodies.